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## Two new species of *Neotyphloceras* (Siphonaptera: Ctenophthalmidae) from Argentinean Patagonia

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### Abstract

Two new species of *Neotyphloceras* Rothschild, parasites of sigmodontine rodents from Argentinean Patagonia, are described and illustrated: *N. crackensis* n. sp. and *N. pardinasi* n. sp. These species are compared with their morphologically closest relatives. Males are characterized by the shape of the upper lobe of the fixed process of clasper; the shape and chaetotaxy of the distal arm of sternum IX and by the shape of the crochet of the aedeagus; females by the contour of the distal margin of sternum VII. *Neotyphloceras pardinasi* n. sp. is reported from western Chubut Province, while *N. crackensis* n. sp. is known from the eastern regions of Chubut and Santa Cruz Provinces. With these reports, the geographical distribution of *Neotyphloceras* is extended to eastern Patagonia. A key to the species and subspecies of *Neotyphloceras* is provided.

**Key words:** Argentina, fleas, key, *Neotyphloceras*, Neotyphloceratini, Patagonia, taxonomy

### Introduction

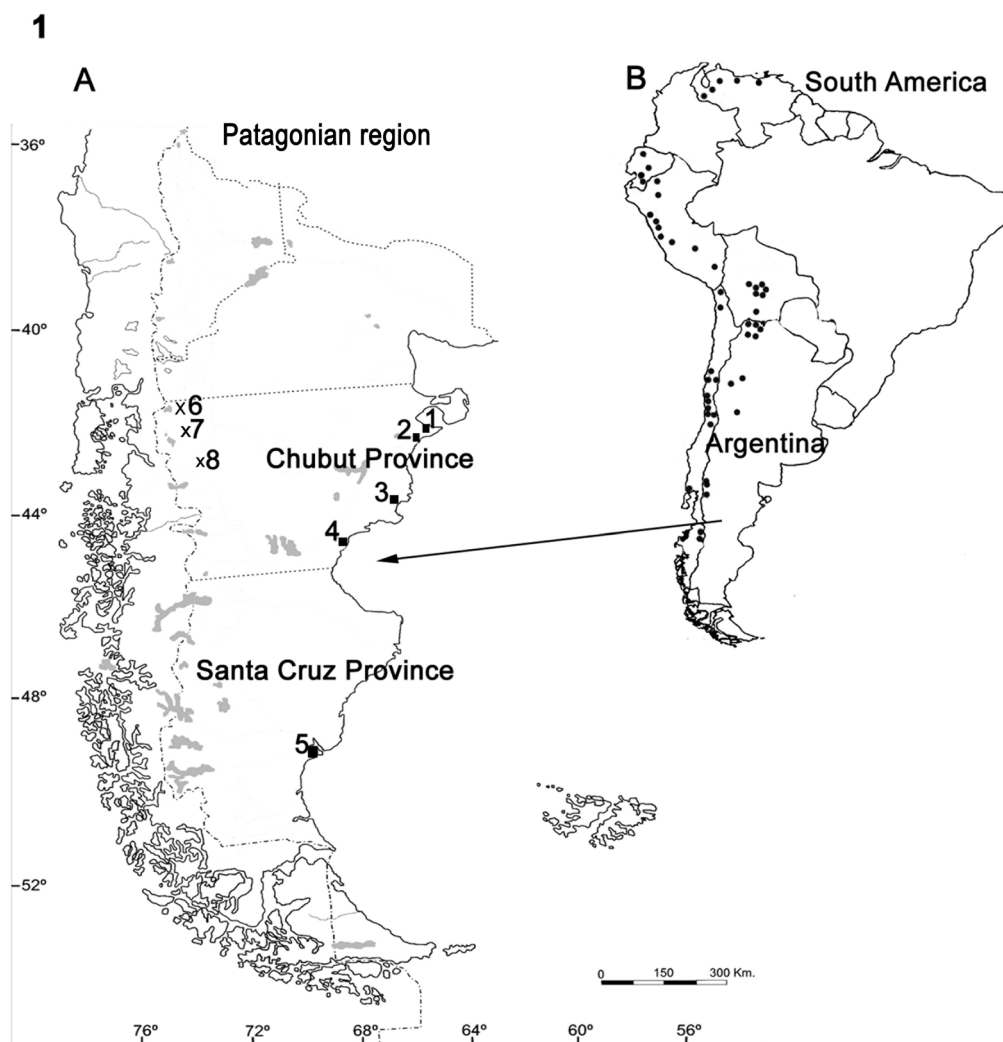
The fauna of fleas (Insecta: Siphonaptera) from the Patagonian region of Argentina is represented by 69 species and subspecies (Beaucournu & Castro 2003; Hastriter & Sage 2009, 2011; Sanchez *et al.* 2009; Sanchez & Lareschi 2013). Of these, three belong to the genus *Neotyphloceras* Rothschild, 1914 (Ctenophthalmidae): *N. chilensis* Jordan, 1936, *N. crassispina crassispina* Rothschild, 1914 and *N. crassispina hemisus* Jordan, 1936, all of them occurring in forest and steppe areas (Beaucournu & Alcover 1990; Sanchez *et al.* 2009). *Neotyphloceras* is an Andean-Patagonian taxon of fleas that are parasites of rodents and marsupials (Hastriter 2001; Lareschi *et al.* 2010; Sanchez *et al.* 2012). Three species and two subspecies of *Neotyphloceras* are distributed from Venezuela to southern Chile and Argentina (Hopkins & Rothschild 1966; Smit 1968; Sanchez *et al.* 2012; Bazán-León *et al.* 2013). Males of these species and subspecies are defined principally on the basis of the length, shape and chaetotaxy of the fixed process of the clasper (Rothschild 1914; Jordan 1936). Females, at the species level, are defined by the shape of sternum VII (Rothschild 1914; Jordan 1936; Sanchez *et al.* 2012). Smit (1968) proposed that females could be distinguished at the subspecies level on the basis of the number and location of the upper lateral setae of tergum VIII. However, this characteristic was not considered, and subsequent subspecific identification of females has been based on accompanying males (Hastriter 2001; Lareschi *et al.* 2010). Herein, we describe two new species of *Neotyphloceras* from Argentinean Patagonia.

### Material and methods

Fleas were collected by examining the pelage of 111 individuals of sigmodontine rodents (Cricetidae) from eight localities in the Patagonian region of Argentina: seven from Chubut Province, and one from Santa Cruz Province (Fig. 1). After collection, fleas were stored in 96% ethanol. In the laboratory fleas were cleared and softened in 10% KOH, dehydrated in an increasing series of ethanol (80% to 100%), further diaphanized in eugenol, and

mounted in Canadian Balsam for study with a microscope equipped with a drawing tube. Fleas were drawn and photographed.

Type-specimens will be deposited in the Colección de Entomología del Museo de La Plata (MLP, La Plata Buenos Aires Province, Argentina), in the “Annexes” of the Colección de Mamíferos del Centro Nacional Patagónico-CENPAT (CNP, Puerto Madryn, Chubut Province, Argentina), and in the Natural History Museum (NHM, London, UK). Currently the specimens are labelled with a field number comprised of the host field number and an additional number for each individual flea from the same host, separated by a hyphen (e.g. PPA 5-1; DUS 494-3). For comparative purposes, original descriptions and figures of the species and subspecies of *Neotyphloceras* from the literature were consulted (Rothschild 1904, 1914; Jordan 1936; Sanchez *et al.* 2012). Holotypes and paratypes of all species and subspecies of *Neotyphlocera* deposited at the Rothschild Collection, Natural History Museum (NHM), were also examined. For morphology nomenclature, we followed Rothschild & Traub (1971). Hosts were captured, processed and identified by Ulyses Pardiñas and his collaborator group (Centro Nacional Patagónico -CENPAT-, Argentina); rodents will be deposited at the Colección de Mamíferos del CENPAT (CNP, Puerto Madryn, Chubut Province, Argentina). The acronyms of the field numbers for each specimen correspond to: PPA (Proyecto Patagonia Agencia); DUS (número de campo Daniel Udrizar Sauthier) and LTU (Proyecto Localidades Tipo).



**FIGURE 1.** Distribution of *Neotyphloceras* Rothschild. A) Geographical distribution of new species of *Neotyphloceras*: (■) *Neotyphloceras crackensis* n. sp. (Chubut Province: 1-Bahía Cracker, 2- Bajo Los Huesos, 3- Puerto Piojo, 4- Pico Salamanca; Santa Cruz Province: 5- Pali Aike); (x) *Neotyphloceras pardinasi* n. sp. (Chubut Province: 6-Cañadón de la Madera, Sierra de Tepuel, 7-Estancia El Maitén, 8-Estancia Leleque). B) (●) Known geographical distribution of *Neotyphloceras* prior to the current study.

## Results

### *Neotyphloceras crackensis* n. sp.

Figures 2–11

**Type specimens.** Holotype male: *ex Graomys griseoflavus* Waterhouse, Bahía Cracker, Chubut Province (42°57'02"S, 64°28'45"W) (MLP-DUS494-2); allotype female: (same data as holotype) (MLP-DUS494-3); paratypes: *ex G. griseoflavus*, 10 males (MLP-DUS465-1, MLP-DUS465-2, MLP-DUS468-1, MLP-DUS468-2, MLP-DUS470, MLP-DUS487-1, CNP-DUS487-2, CNP-DUS494-1, NHM-DUS494-2, NHM-DUS494-4), 3 females (MLP-DUS457, CNP-DUS470, NHM-DUS487-3); *ex Akodon iniscatus* Thomas, 3 males (MLP-DUS461, MLP-DUS464, MLP-DUS471); *ex Reithrodon auritus* G. Fischer, 2 males (MLP-DUS488-1, MLP-DUS488-2), 3 females (MLP-DUS488-1, MLP-DUS488-2, NHM-DUS488-3); *ex Eligmodontia typus* F. Cuvier, 1 male (MLP-DUS489).

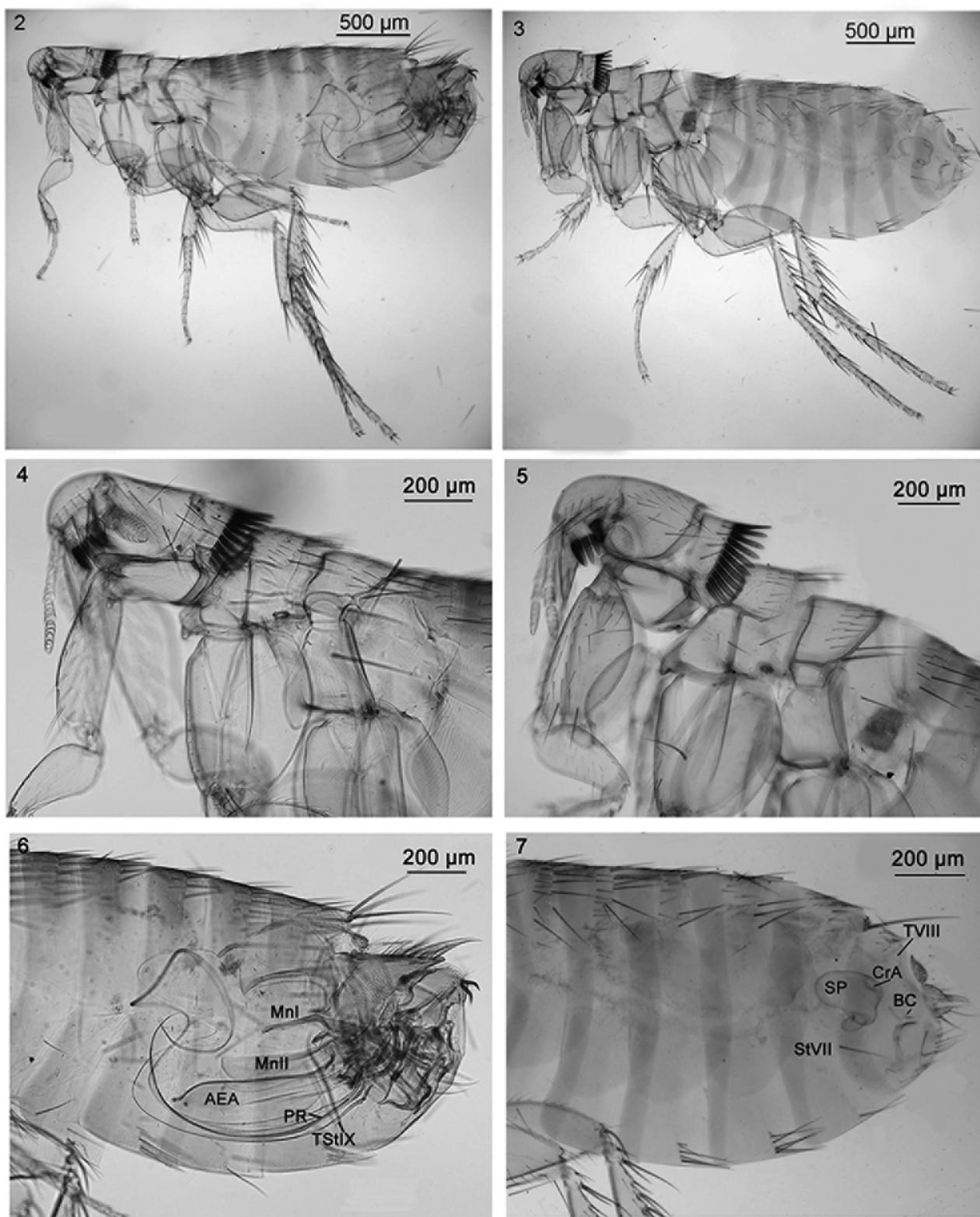
**Additional specimens examined.** *Ex G. griseoflavus*, Bajo Los Huesos, Chubut province (43°11'42.3"S, 64°51'52.1"W), 2 females (DUS497-1, DUS497-2); *ex G. griseoflavus*, Puerto Piojo, Chubut Province (44°53'00.4"S, 65°40'19.2"W), 4 males (DUS589-1, DUS589-2, DUS594, DUS601), 1 female (DUS589-3); *ex E. typus*, 1 female (DUS618); *ex R. auritus*, 1 male (DUS655), 1 female (DUS644); *ex Eligmodontia morgani* Allen, Pico Salamanca, Chubut Province (45°24'32.4"S, 67°25'00"W), 1 male (DUS691), 2 females (DUS741-1, DUS741-2); *ex R. auritus*, 4 males (DUS696, DUS703-1, DUS703-2, DUS703-3), 1 female (DUS696); *ex Abrothrix olivacea* (Waterhouse) 2 males (DUS680, DUS748), 2 females (DUS681, DUS739); *ex A. olivacea*, Pali Aike, Santa Cruz Province (50°06'30"S, 68°27'37"W), 3 males (LTU662, LTU674, LTU675), 3 females (LTU666, LTU668-1, LTU668-2).

The male holotype, female allotype, 12 male and 3 female paratypes and other specimens will be deposited in the Colección de Entomología del Museo de La Plata (MLP). Two male and one female paratypes will be deposited in the "Annexes" of the Colección de Mamíferos del Centro Nacional Patagónico-CENPAT (CNP), and 2 male and 2 female paratypes in the Natural History Museum (NHM).

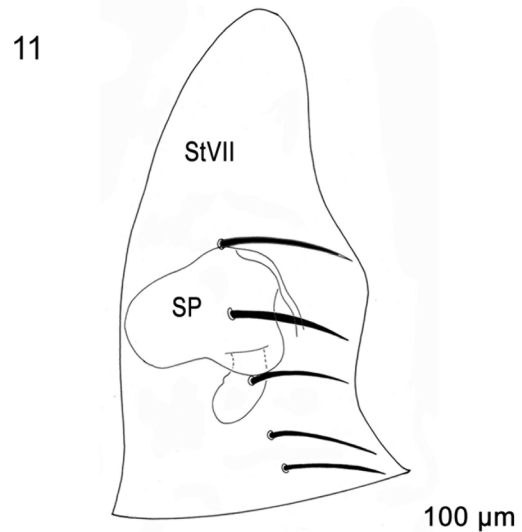
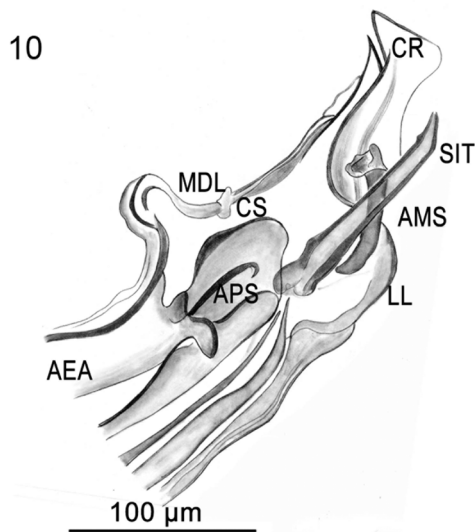
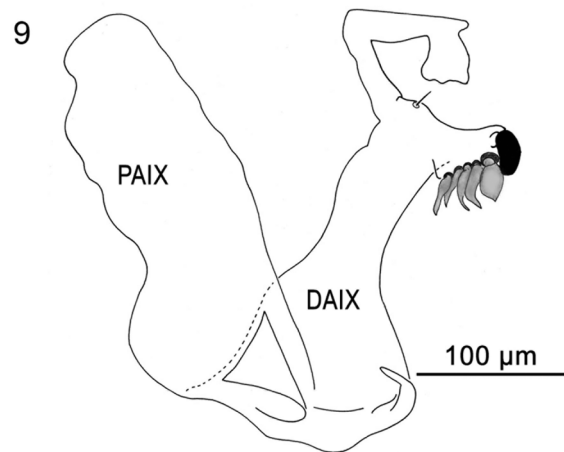
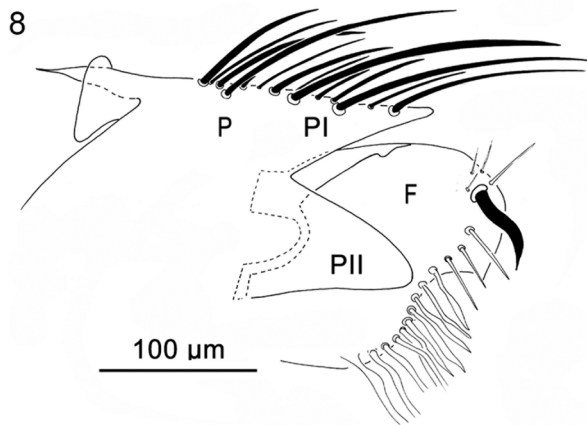
**Diagnosis.** *Neotyphloceras crackensis* n. sp. is similar to *N. crassispina crassispina*, *N. crassispina hemisus* and *N. chilensis* in general appearance but differs from *N. crassispina crassispina* and *N. crassispina hemisus* by the length of the fourth spine of the genal comb and additionally from *N. crassispina hemisus* by the absence of abdominal spinelets. The male of *N. crackensis* n. sp. is similar to *N. chilensis* but differs from *N. crassispina crassispina* and *N. crassispina hemisus* in the location of the last seta of the fixed process of the clasper and by the concavity of the dorsal edge of the distal arm of sternum IX. The male of *N. crackensis* n. sp. is unique in the following characteristics: distal arm of sternum IX with apex forming a projection bearing six curved spine-like setae, five on the ventral margin and one at the apex (in *N. crassispina crassispina* and *N. crassispina hemisus* the dorsal margin is strongly concave and bears six or seven spine-like ventromarginal setae, the first three strongly pigmented and located in the apex above the others; in *N. chilensis* the dorsal margin is slightly concave and bears five ventral, curved spine-like setae, the first seta located in the center above the others); shape of the crochet of the aedeagus, with proximal margin of the apex forming two projections and distal margin almost straight or slightly concave (in *N. chilensis* with one rounded projection on proximal margin and distal margin strongly convex, in *N. crassispina crassispina* and *N. crassispina hemisus* proximal margin with one large projection almost rounded and distal margin almost convex).

The female of *N. crackensis* n. sp. is unique in that the contour of the distal margin of sternum VII bears a conspicuous lobe in the middle. This lobe is located in a lower position in *N. rosenbergi*; while the distal margin is rounded in *N. crassispina crassispina* and *N. crassispina hemisus*, and almost straight in *N. chilensis*.

**Description.** Head (Figs. 2–5) with frons slightly concave, about four times longer than high, with two frontal rows of setae: first row with six or seven equidistant setae on each side, tips exceeding the insertion of setae of the next row; second row with three equidistant setae on each side, the longest seta extending to the distal end of the longest spine of the genal comb. Three placoids along the margin of the frons, without frontal tubercle. Occipital region with four rows of setae (Figs. 4, 5). First antennal segment with 10–15 small setae; second antennal segment with 13–15 short setae reaching the first segment of the clavus; antennal clavus subequal in length to the first antennal segment in males (Figs. 2, 4) and twice the length in females (Figs. 3, 5). A row of small setae bordering antennal fossa: 30–35 in males (Figs. 2, 4) and 15–20 in females and restricted to the caudal margin of the head (Figs. 3, 5). Genal comb with four pointed spines on each side, the first two overlapping and the fourth shorter than



**FIGURES 2–7.** *Neotyphloceras crackensis* n. sp., optical microscope view. 2) Male. 3) Female. 4) Head and thorax of male. 5) Head and thorax of female. 6) Abdomen and modified abdominal segments of male (AEA = aedeagal apodeme; Mnl = upper manubrium; MnII = lower manubrium; PR = penis rod; TStIX = tendon of sternite IX). 7) Abdomen and modified abdominal segments of the female (BC= bursa copulatrix; CrA= cribiform area; SP= spermatheca; StVII = sternum VII; TVIII = tergum VIII).



**FIGURES 8–11. *Neotyphloceras crackensis* n. sp.** 8) Fixed process of the clasper (P) (PI = upper lobe; PII = lower lobe) and movable process (F). 9) Sternite IX of male (DAIX = distal arm of sternite IX, PAIX = proximal arm of sternite IX). 10) aedeagus (AEA = aedeagal apodeme, AMS = apico-median sclerite of aedeagus, APS = apodemal strut of aedeagus, CR = crochet, CS = crescent sclerite of aedeagus, MDL = median dorsal lobe of aedeagus, LL = lateral lobes of aedeagus, SIT = sclerotized inner tube). 11) Sternite VII (StVII) and spermatheca (SP) of female.

the others (60–80% length of longest spine). Preoral margin with two setae on each side. Genal process sharp, subequal in length to the longest spine of the genal comb. Maxillary lobe sharp, extending beyond half of the maxillary palpus. Maxillary palpus four-segmented, reaching to about the middle of the forecoxa, first and second segments subequal in length, third segment shorter and fourth segment longer than the others. Labial palpus five-segmented, long, extending to about the distal edge of forecoxa; first and fifth segment subequal in length and 1.5 times longer than second and third segments. Lacinia slightly serrated and subequal in length to the labial palpus.

Pronotum with one row of four or five long and equidistant setae on each side (Figs. 2–5); pronotal comb with 9–11 spines on each side; length of longest spine subequal to the width of pronotum. Mesonotum with three rows of short setae and one apical row with five or six long setae; mesepisternum with a group of small setae on the anterior region and one or two long setae posteriorly; mesepimere with four or five setae; metanotum with two anterior rows of six short setae and one apical row with five or six long setae; lateral metanotal area long, subequal to pleural arch and with a long seta; pleural arch and ridge well developed; metepisternum with one long seta; furca of metasternum about one fourth the length of the pleural ridge; metepimeron with six long setae and two or three small ones.

On legs (Figs. 2–3) fore coxa with 40–50 setae distributed over entire surface; with one long seta on posterior margin. Middle and hind coxae with setae distributed only on anterior margin (10–14, 20–25, respectively). Fore

femur with a dorsal marginal row of 11–13 small setae and with two rows of 10–12 setae on the inner side. Middle femur with a subventral row of three or four setae on the inner side. Hind femur with a subventral row of five or seven setae on the inner side and six setae on the outer side restricted to the distal region, and with one ventral pair of setae on the proximal margin and one dorsal pair of setae on the distal margin, the longest seta reaching the second notch of the tibia. Middle and hind femora with 20–23 dorsomarginal pairs of small setae. Fore tibia with 10–14 setae on distal half of the outer side. Middle and hind tibia with 15–20 setae on the outer side and five to seven setae on the inner side. All tibiae with eight dorsomarginal notches bearing large setae from apex to base as follows: fore tibia (2; 2; 2; 2; 2; 2; 2; 2); middle and hind tibiae (2; 2; 1-2; 1-2; 2; 2; 2-3; 2); longest caudal setae extending to beyond the middle of the first tarsal segment. First hind tarsal segment more than twice the length of the third and fifth segment and more than four times longer than fourth segment.

Abdomen (Figs. 2–3, 6–7) without spinelets. Tergites II–VI with two rows of setae (anterior 4, posterior 8–10), setae of anterior row shorter than those of the posterior row. Tergum VII with two antesensilial setae on each side. Fossa of spiracle of tergites II–VII short, cone-shaped. Sensillum strongly convex posteriorly, with 13–15 sensilial pits. Sternum III–VI with three or four setae on each side. Dorsal anal lobe long, narrow, cone-shaped, ventral anal lobe conical, shorter than dorsal anal lobe; with two long ventral setae on each side.

Modified abdominal segments in the male (Figs. 6, 8, 9): sternum VII with three or four setae on each side. Tergum VIII with four to six setae above the spiracle. Fixed process of the clasper (P) (Fig. 8): upper lobe (PI) with apex straight; with three or four submarginal setae and one row of eight to ten dorsomarginal setae, the last seta inserted away from the tip by a distance of about twice the width of the fixed process at the point of attachment of the seta; lower lobe (PII) with rounded distal edge and without setae. Movable process (F) (Fig. 8) with one strongly pigmented seta on each side and four to six small setae on the apex; distal margin rounded; ventral margin slightly indented, with a row of 12–15 small setae along its edge. With two branches of the manubrium, the upper (MnI) hook-shaped, shorter and narrower than lower (MnII) (Fig. 6). Acetabulum with a vertical row of 11–14 small spiniform setae; below this row a wide, strongly pigmented, spatulate spine and two narrow, pigment-free setae. Sternum IX (Fig. 9) with proximal arm (PAIX) and distal arm (DAIX) subequal in length; distal arm with apex forming a slightly concave projection bearing one small dorsomarginal seta in the centre and six curved, spine-like ventromarginal setae, the first seta strongly pigmented and located in the apex.

Aedeagus (Figs. 6, 10) with aedeagal apodeme (AEA) long, more than six times longer than broad. Median dorsal lobe (MDL) strongly sclerotized. Lateral lobes (LL) present. Sclerotized inner tube (SIT) long, straight, narrow. Apical median sclerite (AMS) present, shorter than inner tube and located near the middle of the inner tube. Crochet of aedeagus (CR) apical, with long base, apex with proximal margin forming two projections, upper projection longer and wider than lower projection; distal margin almost straight. Two long apodemal struts (APS), proximal strut larger than distal strut and with dorso-proximal margin sclerotized. Crescent sclerite (CS) conspicuous above apodemal strut. Penis rod (PR) uncoiled, with a fold in the anterior portion and subequal to or longer than the tendon of sternite IX (TStIX) (Fig. 6). Without dorsal membranous lobe arising from the dorsal portion of the aedeagus.

Modified abdominal segments of the female (Figs. 7, 11): sternum VII (StVII) (Fig. 11) with five setae, apical margin narrow and contour of the distal margin with conspicuous lobe in the middle. Sternum VIII narrow, elongated and less sclerotized than the other segments. Tergum VIII (TVIII) (Fig. 7) with long, narrow, oblique spiracles; with small setae placed above the spiracle, the upper lateral seta situated at a variable distance from ventral margin to lowest level of spiracular fossa; distal margin with a small lobe and three or four short, wide, spiniform setae. Anal stylet subapical, more than two times longer than broad at base, with a long apical setae more than twice the length of anal stylet. Spermatheca (SP) (Figs. 7, 11) with bulga larger than the hilla, cribiform area (CrA) (Fig. 7) circular and heavily sclerotized. Bursa copulatrix (BC) (Fig. 7) strongly sclerotized, bifurcated (Y-shaped).

**Etymology.** This species is named for the type locality where the holotype specimen was collected, Bahía Cracker, Chubut Province, Argentina.

### *Neotyphloceras pardinasi* n. sp.

Figures 12–21

**Type specimens.** Holotype male: *ex Abrothrix longipilis* (Waterhouse) Cañadón de la Madera, Sierra de Tepuel,

Chubut Province (43°51'55"S, 70°43'34"W), (MLP-PPA5-1); allotype female, (MLP-PPA5-2); Paratypes: *ex A. longipilis*, 4 males (MLP-PPA5-3, MLP-PPA11, NHM-PPA18, CNP-PPA68-1), 3 females (NHM-PPA14, CNP-PPA68-2, MLP-PPA69); *ex Loxodontomys micropus* Waterhouse, 4 males (MLP-PPA17, MLP-PPA 22, MLP-PPA40-1, MLP-PPA 40-2); *ex Euneomys chinchilloides* (Waterhouse), 2 males (MLP-PPA31-1, MLP-PPA31-2); *ex E. morgani*, 1 male (MLP-PPA56); *ex Phyllotis xanthopygus* (Waterhouse), 2 females (MLP-PPA54, MLP-PPA89); *ex Chelemys macronyx* (Thomas), 4 females (MLP-PPA59, MLP-PPA66, MLP-PPA67, MLP-PPA96).

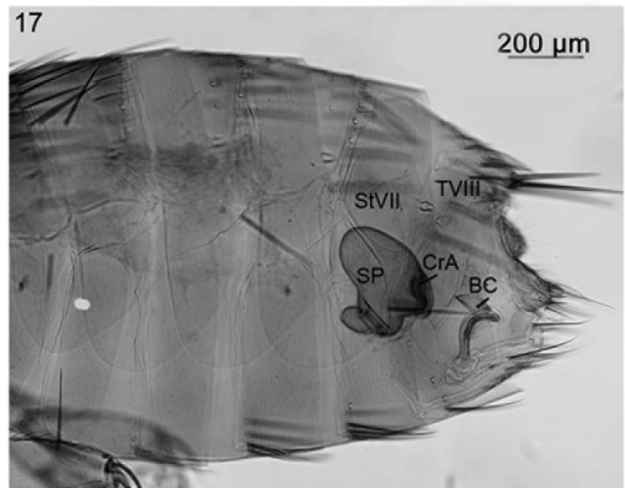
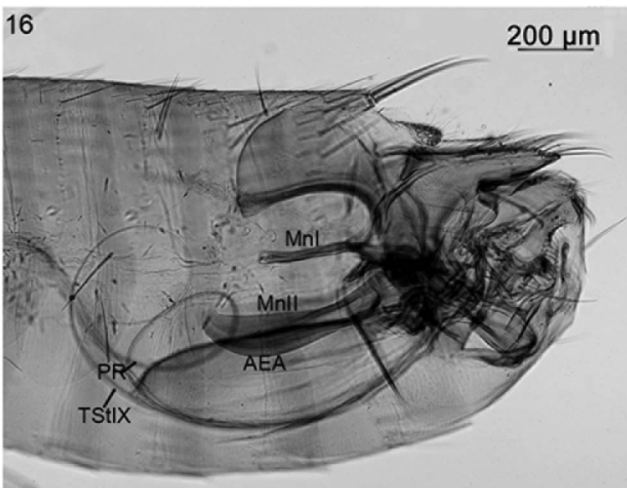
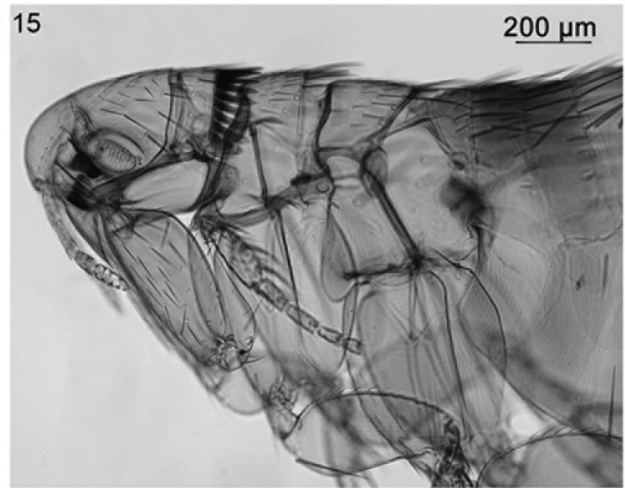
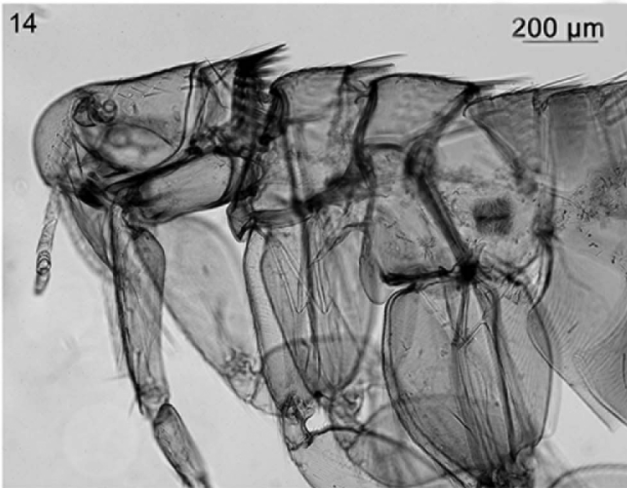
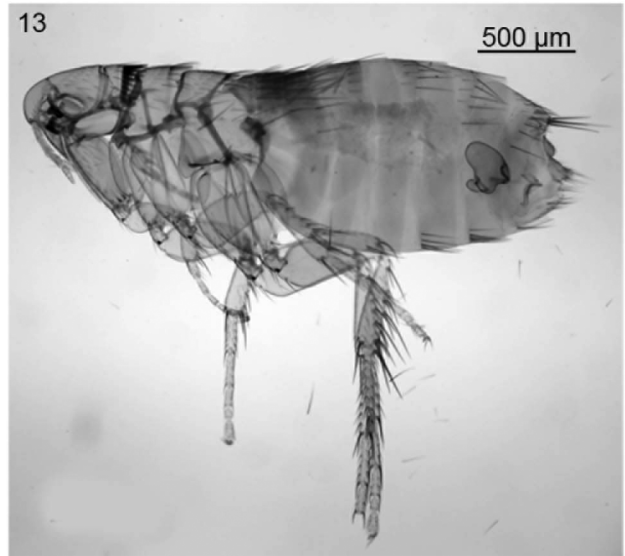
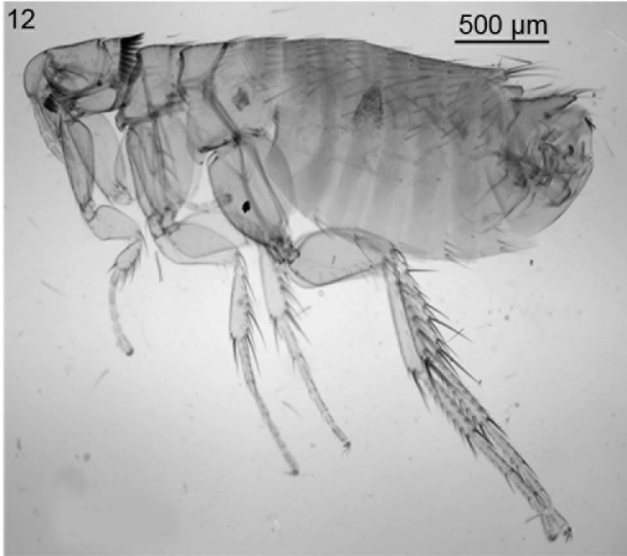
**Additional specimens examined.** *Ex A. longipilis*, Ea. El Maitén, Chubut Province (42°03'34", 71°09'48"W), 10 males (LTU495, LTU496-1, LTU496-2, LTU505-1, LTU505-2, LTU507, LTU508, LTU509, LTU511-1, LTU511-2), 1 female (LTU504); *ex A. olivacea*, 2 males (LTU504-1, LTU504-2); *ex A. longipilis*, Ea. Leleque, Chubut Province (42°19'56"S, 70°59'00"W), 8 males (DUS125-1, DUS125-2, DUS141-1, DUS141-2, DUS143-1, DUS143-2, DUS172, DUS174), 3 females (DUS125, DUS141, DUS173); *ex A. olivacea*, 1 female (DUS155).

The male holotype, female allotype, 8 male and 7 female paratypes and other specimens will be deposited in the Colección de Entomología del Museo de La Plata (MLP). Two male and 1 female paratypes will be deposited in the "Annexes" of the Colección de Mamíferos del Centro Nacional Patagónico-CENPAT (CNP), and 2 male and 1 female paratypes in the Natural History Museum (NHM).

**Diagnosis.** *Neotyphloceras pardinasi* **n. sp.** is similar to *N. chilensis*, *N. crackensis* **n. sp.**, *N. crassispina crassispina* and *N. crassispina hemisus* in general appearance, but differs from *N. chilensis* and *N. crackensis* **n. sp.** by the length of the fourth spine of the genal comb and from *N. crassispina hemisus* by the absence of abdominal spinelets. The male of *N. pardinasi* **n. sp.** is similar to *N. crassispina crassispina* and *N. crassispina hemisus* but differs from *N. chilensis* and *N. crackensis* **n. sp.** in the location of the last seta of the fixed process of the clasper and by the concavity of the dorsal edge of the distal arm of the sternum IX. Male *N. pardinasi* **n. sp.** are unique in the shape of the apex of the crochet of the aedeagus, the proximal margin with one large pointed projection, forming an angle  $\leq 45^\circ$  and distal margin straight, (*N. crassispina crassispina* and *N. crassispina hemisus* with proximal margin bearing one large, almost rounded projection and distal margin almost convex; *N. crackensis* **n. sp.** with proximal margin of the apex forming two projections and distal margin almost straight or slightly concave; *N. chilensis* with one rounded projection on proximal margin and distal margin strongly convex). Furthermore, in males of *N. pardinasi* **n. sp.** the apex of the distal arm of sternum IX bears one small dorsomarginal seta in the centre and seven curved, spine-like ventromarginal setae, the first seta strongly pigmented and located above the others (*N. crassispina crassispina* and *N. crassispina hemisus* with six or seven spine-like ventromarginal setae, the first three strongly pigmented and located at the apex above the others; in *N. crackensis* **n. sp.** apex forming a projection bearing six curved spine-like setae, five on ventral margin and one on the apex; in *N. chilensis* dorsal margin slightly concave and bearing five ventral, curved spine-like setae, the first seta located in the centre above the others).

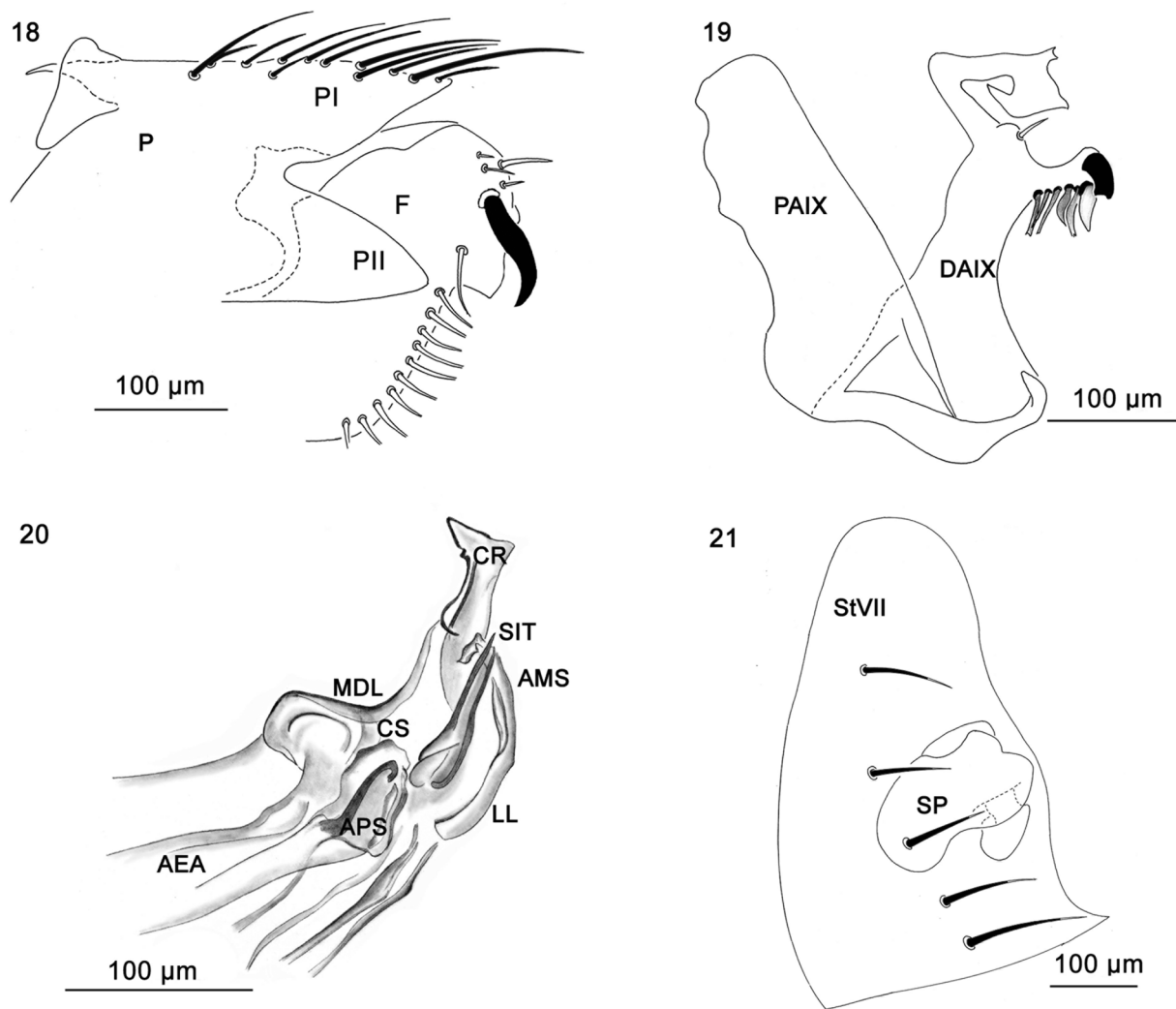
The female of *N. pardinasi* **n. sp.** is unique in that the apical margin of sternum VII is wide and the contour of the distal margin is strongly convex in the lower portion; while the distal margin in *N. crassispina crassispina* and *N. crassispina hemisus* is rounded, in *N. crackensis* **n. sp.** bearing a lobe in the middle, in *N. rosenbergi* bearing a lobe in the lower portion and in *N. chilensis* almost straight.

**Description** (Figs. 12–21). Head (Figs. 12–15) with frons slightly concave, about four times longer than high, with two frontal rows of setae: first row with six or seven equidistant setae on each side, tips exceeding the insertion of setae of the next row; second row with three equidistant setae on each side, the longest seta extending to the distal end of the longest spine of the genal comb. Three placoids along the margin of the frons, without frontal tubercle. Occipital region with four rows of setae. First antennal segment with 10–15 small setae; second antennal segment with 13–15 short setae reaching the first segment of the clavus; antennal clavus subequal in length to the first antennal segment in males (Fig. 14) and twice the length in females (Fig. 15). A row of small setae bordering antennal fossa: 30–35 in males (Fig. 14), 15–20 in females and restricted to the caudal margin of head (Fig. 15). Genal comb with four pointed spines, the first two overlapping and the fourth shorter than the others ( $< 60\%$  of the length to the longest spine). Preoral edge with two setae on each side. Genal process pointed, subequal in length to the longest spine of the genal comb. Maxillary lobe pointed extending beyond half of the maxillary palpus. Maxillary palpus four-segmented, reaching to about the middle of the forecoxa; first and second segments subequal in length; third segment shorter and fourth segment longer than the others. Labial palpus five-segmented, long, extending to about the distal edge of the forecoxa; first and fifth segment subequal in length and 1.5 times longer than second and third segments. Lacinia slightly serrated and subequal in length to the labial palpus.



**FIGURES 12–17.** *Neotyphloceras pardinasi* n. sp., optical microscope view. 12) Male. 13) Female. 14) Head and thorax of male. 15) Head and thorax of female. 16) Abdomen and modified abdominal segments of male (AEA= aedeagal apodeme; Mnl = upper manubrium; MnII = lower manubrium; PR= penis rod; TStIX = tendon of sternite IX). 17) Abdomen and modified abdominal segments of the female (BC = bursa copulatrix; CrA = cribiform area; SP = spermatheca; StVII = sternum VII; TVIII = tergum VIII).





**FIGURES 18–21.** *Neotyphloceras pardinasi* n. sp. 18) Fixed process of the clasper (P) (PI = upper lobe; PII = lower lobe) and movable process (F). 19) Sternite IX of male (DAIX = distal arm of sternite IX, PAIX = proximal arm of sternite IX). 20) Aedeagus (AEA = aedeagal apodeme, AMS = apico-median sclerite of aedeagus, APS = apodemal strut of aedeagus, CR = crochet, CS = crescent sclerite of aedeagus, MDL = median dorsal lobe of aedeagus, LL = lateral lobes of aedeagus, SIT = sclerotized inner tube). 21) Sternite VII (StVII) and spermatheca (SP) of female.

Pronotum with one row of 4 or 5 long, equidistant setae on each side; pronotal comb with 8–11 spines on each side; length of longest spine subequal to the width of pronotum (Figs. 14, 15). Mesonotum with three rows of short setae and one apical row with five or six long setae; mesepisternum with a group of small setae on the anterior region and one or two long setae posteriorly; mesepimere with four or five setae; metanotum with two anterior rows of six short setae and one apical row with five or six long setae; lateral metanotal area long, subequal to pleural arch and with a long seta; pleural arch and ridge well developed; metepisternum with one long seta; furca of metasternum about one fourth the length of the pleural ridge; metepimere with six long setae and two or three small ones.

Fore coxa with 40–50 setae distributed over entire surface; with one long seta on posterior margin (Figs. 12, 13). Middle and hind coxae with setae distributed only on anterior margin (10–14, 20–25, respectively). Fore femur with a dorsal marginal row of 11–13 small setae and with a subventral row of five or six setae on the inner side. Middle femur with a subventral row of five or six setae on the inner side. Hind femur with a subventral row of five or seven setae on the inner side and seven or nine setae on the outer side restricted to the distal region, and with one ventral pair of setae on the proximal margin and one dorsal pair of setae on the distal margin, the longest seta reaching the second notch of the tibia. Middle and hind femora with 20–23 dorsomarginal pairs of small setae. Foretibia with 10–14 setae on distal half of the outer side. Middle and hind tibia with 15–20 setae on the outer side

and five to seven setae on the inner side. All tibiae with eight dorsomarginal notches bearing large setae from apex to base as follows: foretibia (2; 2; 2; 2; 2; 2; 2; 2); middle and hind tibia (2; 2; 1–2; 1–2; 2; 2; 2–3; 2); longest caudal setae extending to beyond the middle of the first tarsal segment. First hind tarsal segment more than twice the length of the third and fifth segment and more than four times longer than fourth segment.

Abdomen (Figs. 12–13, 16–17) without spinelets. Tergites II–VI with two rows of setae (anterior 4, posterior 8–10), setae of anterior row shorter than those of the posterior row (Figs. 16–17). Tergum VII with two antesensilial setae on each side. Fossa of spiracle of tergites II–VII long (length twice the width), cone-shaped. Sensillum strongly convex posteriorly, with 13–15 sensillial pits. Sterna III–VI with three or four setae on each side. Dorsal anal lobe long, narrow, cone-shaped, ventral anal lobe conical, shorter than dorsal anal lobe; with two long ventral setae on each side.

Modified abdominal segments of the male (Figs. 16, 18–19): Sternum VII with three or four setae on each side. Tergum VIII with four to six setae above the spiracle. Fixed process of the clasper (P) (Fig. 18) with upper lobe (PI) cone-shaped, robust, distal margin and proximal margin forming an angle  $\leq 45^\circ$ ; with three or four submarginal setae and one row of 8–10 dorsomarginal setae, the last seta arising from the tip by distance equal to the width of the fixed process at the point of attachment of the seta; lower lobe (PII) with sharp distal edge and without setae. Movable process (F) (Fig. 18) with one strongly pigmented seta on each side and four to six small setae on the apex; distal margin rounded; ventral margin slightly indented, with a row of 11–15 small setae along its edge. With two branches of the manubrium, the upper (MnI) hook-shaped, shorter and narrower than lower (MnII) (Fig. 16). Acetabulum with a vertical row of 11–14 small spiniform setae; below this row a wide, strongly pigmented spatulated spine and two narrow, unpigmented setae. Sternum IX (Fig. 19) with proximal arm (PAIX) and distal arm (DAIX) subequal in length; distal arm with apex forming a strongly concave projection bearing one small dorsomarginal seta in the centre and seven curved, spine-like ventromarginal setae, the first seta strongly pigmented and located in the apex.

Aedeagus (Figs. 16, 20) with long aedeagal apodeme (AEA), more than six times longer than broad. Median dorsal lobe (MDL) strongly sclerotized. Lateral lobes (LL) present. Sclerotized inner tube (SIT) long, straight, narrow. Apical median sclerite (AMS) present, shorter than inner tube and located near the middle of the inner tube. Crochet of aedeagus (CR) apical, apex with proximal margin forming one large pointed projection, at an angle  $\leq 45^\circ$ , distal margin straight. Two long apodemal struts (APS), proximal strut greater than distal strut and with dorso-proximal margin sclerotized. Crescent sclerite (CS) conspicuous above apodemal strut. Penis rod (PR) uncoiled, with a fold in the anterior portion and subequal to or longer than the tendon of sternite IX (TStIX) (Fig. 16). Without dorsal membranous lobe arising from the dorsal portion of the aedeagus.

On modified abdominal segments of the female (Figs. 17, 21) sternum VII (StVII) (Fig. 21) with five setae, apical margin wide, contour of the distal margin convex in the lower portion. Sternum VIII narrow, elongated and less sclerotized than the other segments. Tergum VIII (TVIII) (Fig. 17) with long, narrow, oblique spiracles; with small setae placed above the spiracle, the upper lateral seta situated at a variable distance from ventral margin to lowest level of spiracular fossa; distal margin with a small lobe and three or four short, wide, spiniform setae. Anal stylet subapical, more than two times longer than broad at base, with a long apical setae more than twice the length of anal stylet. Spermatheca (SP) (Figs. 17, 21) with bulga larger than the hilla, cribiform area (CrA) (Fig. 17) circular and heavily sclerotized. Bursa copulatrix (BC) (Fig. 17) strongly sclerotized, bifurcated (Y-shaped).

**Etymology.** The species is named after Dr. Ulyses F. J. Pardiñas (Centro Nacional Patagónico-CONICET, Argentina), not only for his important contributions to the knowledge of sigmodontines, but for his interest in their parasites. In honouring Dr. Pardiñas, we also express our gratitude for his support during our studies on ectoparasites of small mammals.

### Key to species and subspecies of *Neotyphloceras*

(modified from Hopkins & Rothschild (1966) and Sanchez *et al.* (2012))

1. With a frontal tubercle; frons six times longer than high; first frontal row with eight or nine setae on each side; chaetotaxy of dorsal margin of hind tibia 2; 2; 2; 2; 1; 2; 2; inner side of hind femur with two or three subventral setae; apical seta of movable process of clasper slightly pigmented; fixed process with three or four marginal setae, without submarginal setae; sternum VII in female with four setae and a well-developed, rounded lobe on lower portion of distal margin . . . . . *N. rosenbergi*
- Without a frontal tubercle; frons four times longer than high; first frontal row with six or seven setae on each side; chaetotaxy

- of dorsal margin of hind tibia 2; 2; 1–2; 1–2; 2; 2; 2–3; 2; inner side of hind femur with five to seven subventral setae; apical seta of movable process of clasper dark; fixed process with eight to ten marginal setae, and three or four submarginal setae; sternum VII in female with five setae and distal margin rounded, almost straight, convex in the lower portion or with conspicuous lobe in the middle . . . . . 2
2. Second and/or third abdominal tergites with one to three dorsal spinelets on each side . . . . . *N. crassispina hemisus*
- Abdominal tergites without dorsal spinelets . . . . . 3
3. Males with last distal marginal seta on the fixed process of the clasper at tip or removed from tip by distance equal to the width of the fixed process at the point of attachment of the seta; distal arm of sternum IX with dorsal margin strongly concave. Female sternum VII with apical margin wide and distal margin rounded or convex in the lower portion. . . . . 4
- Males with last distal marginal seta on the fixed process of the clasper removed from tip by distance of about twice the width of the fixed process at the point of attachment of the seta; distal arm of sternum IX with dorsal margin slightly concave. Female sternum VII with apical margin narrow and distal margin almost straight or with conspicuous lobe in the middle . . . . . 5
4. Males with last distal marginal seta on the fixed process of the clasper at tip of the process; apex of the crochet of the aedeagus with proximal margin bearing a large, almost rounded projection; distal arm of sternum IX with six or seven spine-like ventromarginal setae, the first three strongly pigmented and located in the apex above the others. Females with distal margin of sternum VII rounded . . . . . *N. crassispina crassispina*
- Males with last distal marginal seta on the fixed process of the clasper separated from its tip; apex of the crochet of the aedeagus with proximal margin bearing a large pointed projection, forming an angle  $\leq 45^\circ$ , distal arm of sternum IX with apex bearing one small dorsomarginal seta in the centre and seven curved setae, the first seta strongly pigmented. Female sternum VII with distal margin convex in the lower portion. . . . . *N. pardinasi n. sp.*
5. Males with the upper lobe of the fixed process of clasper with apex clearly turned up; lower lobe of the fixed process with sharp distal edge; movable process with distal margin almost straight and ventral margin strongly indented; distal arm of sternum IX bearing five curved spine-like setae, the first seta located in the centre above the others; crochet with rounded projection on proximal margin and distal margin strongly convex. Females with distal margin of sternum VII almost straight . . . . .
- ..... *N. chilensis*
- Males with upper lobe of the fixed process of clasper with apex almost straight; lower lobe of the fixed process with rounded distal edge; movable process with distal margin rounded and ventral margin slightly indented; distal arm of sternum IX bearing six curved spine-like setae, the first one located at the apex; crochet of the aedeagus with two angular projections on proximal margin and distal margin almost straight or slightly concave. Sternum VII in females with conspicuous lobe in the middle of distal margin . . . . . *N. crackensis n. sp.*

## Discussion

General morphology of the two new species is consistent with the genus *Neotyphloceras*. *Neotyphloceras crackensis n. sp.* is morphologically closer to *N. chilensis* than to the other species and subspecies of the genus. *Neotyphloceras chilensis*, however, is mainly distributed geographically west of the Andes (Hopkins & Rothschild 1966; Sanchez *et al.* 2012), while *N. crackensis n. sp.* has been found on the Atlantic coast of Chubut and Santa Cruz Provinces, in localities of Monte Desert and steppe of the Patagonian region. These records comprise the first mention of the genus in Monte Desert areas and near the Atlantic coast of Patagonian region. Moreover, the finding of *N. crackensis n. sp.* in Bahía Cracker, Chubut Province (42°57'02"S, 64°28'45"W), represents the easternmost record for *Neotyphloceras*, and Pali Aike, Santa Cruz Province (50°06'30"S; 68°27'37"W), the southernmost record for the genus (Fig. 1). The geographical distribution of *N. pardinasi n. sp.* includes localities of the western subandean steppes and grasslands, located in western Chubut province near the Andes; these records are consistent with the known geographical distribution of *Neotyphloceras* (Sanchez *et al.* 2012). Finally, *Chelemys macronyx* and *Euneomys chinchilloides* constitute new hosts for the genus *Neotyphloceras*.

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